. WO2024241184 - STERILIZATION DEVICE

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[EN]

Sterilization Device

Technical Field

[0001] The present invention relates generally to sterilization and inactivation of virus, bacteria and pathogens and disinfection technologies, and more specifically to a surface-mounted device for sanitizing and disinfecting various surfaces using ultraviolet (UVC) radiation. This invention is particularly relevant to applications in healthcare settings, food and beverage processing facilities,

pharmaceutical manufacturing, public transportation systems, hospitality industries, government facilities, militaiy facilities, educational institutions, and other environments where maintaining high standards of hygiene is critical.

Background of the Invention

[0002] The use of ultraviolet light for sterilization and disinfection has been in our society for a long time. I first noticed it in mainstream use in a tattoo parlor in the mid 1990's in New York City. The artist would further disinfect after manually cleaning their tools too sterilize them before hermetically sealing them for their next client. Until recently the Ultraviolet light waves have been harmful due to their wave size. Now however with newly manufactured UV-C classification, structural technologies for housings and other safety features the radiation emitting diodes and bulbs are now safe for public spaces, businesses and homes.

[0003] The use of photovoltaic cells has been around for many decades and is common in today's society. Being utilized for powering objects from pocket calculators, entire homes, structures, and vehicles too name o few of their many applications.

[0004] The electronic components used are veiy common and utilized globally for decades due to their reliability and longevity. The more recently developed parts produce a compact streamline self-contained disinfection unit with time delay motion sensor capability and a long life cycle. The prior art abounds with numerous disinfection systems which can be used with various types of UV light sources. In particular, UV disinfecting is widely used in hospitals, healthcare facilities, doctor's offices, and similar environments where germs can easily spread by virtue of human interaction with patients, instruments, surfaces, and the like. There are many commercially available UV disinfectant systems which can be installed in hospitals or similar facilities where curtailment of the spread of germs is paramount. U.S. Patent 9,901,652, which is incorporated herein by reference for all purposes, discloses a UV disinfection apparatus that can be used in a hospital or similar facility.

[0005] Traditional chemical disinfectants, such as bleach and alcohol, are effective but require careful handling and may leave harmful residues. Autoclaves and steam sterilization methods, while highly effective, are typically large and expensive, making them unsuitable for all environments.

[0006] Ultraviolet germicidal irradiation (UVGI) systems have been developed to use UVC light for disinfecting air, water, and surfaces. However, these systems are often stationary and not suitable for portable applications. Portable UVC sterilization wands have been introduced for personal use, but they require manual operation and may not consistently deliver the necessary UVC dosage for effective sterilization.

[0007] Solar-powered devices using photovoltaic cells are commonly used in various applications, including calculators, outdoor lighting, and remote sensors. While these devices efficiently harness solar energy, their application in continuous and effective sterilization systems has been limited.

[0008] Additionally, electrostatic sprayers and chemical fogging systems have been employed for disinfection purposes. These systems rely on chemical disinfectants, which can be hazardous and require safety precautions. Ozone generators and ionization air purifiers also provide disinfection capabilities but have limitations such as potential health hazards and lack of active microorganism killing.

[0009] The current invention seeks to overcome these limitations by providing a surface mountable, energy-efficient UVC sterilization device that utilizes motion sensors, photovoltaic cells, rechargeable batteries, timing module and adjustable deflectors. This combination ensures effective and safe sterilization of surfaces and air in various settings, improving upon existing technologies by offering enhanced safety, efficiency, and ease of use.

[0010] Here listed are existing technologies and some of their negative aspects;

1. Ionization Air Purifiers: Ionization air purifiers generate charged ions that attach to airborne particles, causing them to clump together and fall out of the air. While effective in improving air quality, they do not actively kill microorganisms and may produce ozone, which can be harmful in high concentrations.

2. Chemical Fogging Systems: Chemical fogging systems disperse disinfectant chemicals in a fine mist to disinfect large areas. These systems are effective for large-scale disinfection but involve the use of potentially hazardous chemicals and require safety precautions during operation.

3. Ozone Generators: Ozone generators produce ozone to disinfect air and surfaces. Ozone is a powerful oxidizing agent that can kill microorganisms, but its use is limited due to the potential health hazards associated with ozone exposure.

4. Pulsed Xenon UV Light Systems: Pulsed xenon UV light systems use intense, broad-spectrum UV light pulses to disinfect surfaces and air. These systems are effective but can be expensive and require safety measures to protect users from UV exposure.

5. Microbial Detection and Identification Systems: Systems for detecting and identifying microbial contamination, such as ATP (adenosine triphosphate) bioluminescence assays, are used to monitor cleanliness. While these systems can identify contamination, they do not provide a means of disinfection.

6. Handheld UVC Sterilizers: Handheld UVC sterilizers are portable devices used for personal disinfection of small items and surfaces. These devices require manual operation and may not ensure consistent exposure to UVC light for effective sterilization.

7. Fixed UVC Ceiling Lights: UVC ceiling lights are installed in healthcare and laboratory settings to provide continuous air and surface disinfection. These systems are effective but limited to fixed locations and require safety measures to prevent human exposure to UVC light.

8. Far-UVC Light Technology: Far-UVC light (222 nm) is a newer technology that is effective in killing bacteria and viruses while being safer for human exposure compared to traditional UVC light. This technology is still being researched and has limited commercial availability.

9. Automated UVC Disinfection Robots: UVC disinfection robots are autonomous machines equipped with UVC lamps that navigate through spaces to disinfect surfaces and air. While highly effective, these robots are expensive and primarily used in large facilities like hospitals.

Brief Description of the Invention

[0011] The Sterilization Device is a self-contained UVC sterilization unit equipped with a UVC source. It is designed for surfaces requiring sterilization. The unit comprises motion sensors, photovoltaic cells, batteries, and UVC emitting technology. The Sterilization Device detects motion and initiates the UVC sanitation cycle once motion ceases. If new motion is detected, the cycle halts

immediately and resumes when the motion stops. This reduces the dependency on chemical cleaning agents.

[0012] The device can be mounted on any surface needing disinfection or an adjacent surface. It utilizes reflective technology to channel UVC waves, with slight directional capability for casting UVC radiation. This is achieved through a door with a reflective panel that opens, broadening the target surface area, and an adjustable deflector for further directional control.

[0013] The device is primarily linear in shape, except for smaller versions that create a square profile due to their compact width, which necessitates relocating photocells to the unit's side and top. Longer units can house sufficient photocells on the front surface without needing additional cells on the sides or top. Sanitation Device model includes an external power port for use in high-traffic areas and is equipped with a power backup system.

[0014] The unit includes a power backup system to ensure continuous operation during power outages. It also features an adjustable deflector for enhanced directional control and a reflective panel on the door to maximize the sterilization surface area. The compact design allows for easy installation on various surfaces, making it versatile for different applications.

[0015] Larger units can house more photocells on the front surface, eliminating the need for additional cells on the sides or top. The PLU1.0 model includes an external power port for high-traffic areas and is equipped with a power backup system.

[0016] This device offers a practical solution for reducing chemical dependency in cleaning and disinfection processes, thereby enhancing safety and efficiency in maintaining sterile environments.

Detailed Description of the Invention:

[0017] The invention comprises a sterilization device that utilizes UVC emissions for sterilizing surfaces. Key components include a UVC source, motion sensors, photovoltaic cells, batteries, and an adjustable deflector. Motion sensors detect movement and activate the UVC cycle when no motion is detected for a specified period. The device can be powered by photovoltaic cells, batteries, or an external power source, providing flexibility in various settings.

[0018] The UVC source is mounted within a housing featuring reflective surfaces to effectively direct UVC emissions. The housing is designed to prevent UVC leakage, ensuring safe operation. Its compact design allows for easy installation on various surfaces, and the adjustable deflector enhances versatility by allowing UVC emissions to be directed as needed.

[0019] Motion sensors are integrated into the housing and programmed to activate the UVC cycle when no motion is detected within a specified range. This ensures the device operates only when it is safe, minimizing the risk of exposure to UVC emissions. The sensors can be calibrated to detect motion at different distances, offering adjustable sensitivity and adjustable timer settings.

[0020] Photovoltaic cells are strategically placed on the device to maximize light exposure, ensuring efficient energy collection. Batteries provide backup power, allowing continuous operation even in low-light conditions or during power outages. The external power port offers an additional power option for high-traffic areas where the device is used more frequently.

[0021] The adjustable deflector is a key feature, allowing precise direction of UVC emissions. The deflector can be adjusted manually or automatically, depending on the model, providing flexibility

in various applications. The reflective panel on the door enhances effectiveness by increasing the serializable surface area.

[0022] The device's housing is constructed from durable materials that can withstand exposure to UVC radiation and various environmental conditions. It includes a door mechanism for easy access to internal components for maintenance and cleaning.

[0023] The invention also features a control system that allows users to program the UVC cycle duration and adjust the sensitivity of the motion sensors. This control system can be accessed via a user interface (switch) on the device or remotely through a connected network, providing flexibility in managing the device's operation and ensuring it can be customized to meet specific environmental needs.

[0024] The motion sensor module (204) in the device is highly sensitive, capable of detecting movement within a specified range. These sensors can be calibrated to different sensitivity levels, tailoring the device to various settings. Upon detecting motion, the UVC cycle halts immediately to prevent UVC exposure. The cycle begins anew once motion ceases, ensuring continuous surface sterilization.

[0025] The device uses high-efficiency photovoltaic cells to convert light into electrical energy. These cells are strategically placed to maximize light exposure, enabling effective operation in various lighting conditions. Rechargeable batteries provide backup power, ensuring continuous operation during low-light conditions or power outages.

[0026] The external power port allows connection to an external power source, offering additional flexibility in high-traffic areas. This ensures continuous operation in environments where the device is most needed. The power port is designed to be compatible with standard power sources, facilitating easy integration into existing infrastructure.

[0027] The motion sensor module (204) delays the disinfection cycle. When motion ceases, the timer module (206) activates the disinfection cycle. The device is designed to provide thorough and efficient sterilization, ensuring surfaces are properly disinfected without manual intervention. The use of photovoltaic cells and rechargeable batteries allows the device to operate sustainably, reducing reliance on external power sources.

[0028] The adjustable deflector (26) and reflective panel (15) enhance the device's ability to direct UVC emissions precisely where needed, increasing the effectiveness of the sterilization process. These features allow the device to be customized for different applications, ensuring it meets the specific needs of various environments.

[0029] The invention includes a safety mechanism that prevents the UVC source from being activated while the device is in motion, reducing the risk of accidental UVC radiation exposure. This safety mechanism is crucial, ensuring safe use in a wide range of settings.

[0030] The device is designed for easy installation and maintenance, with a user-friendly interface for simple operation. The housing is made from durable materials that withstand exposure to UVC radiation and environmental conditions, ensuring long-lasting performance. The design also includes features that facilitate easy cleaning and maintenance, ensuring effective operation over time.

[0031] The invention offers a versatile and effective solution for surface sterilization, utilizing UVC emissions to disinfect surfaces thoroughly and efficiently. The combination of motion sensors, photovoltaic cells, rechargeable batteries, and adjustable deflectors ensures the device can operate in various settings, providing reliable and sustainable sterilization.

[0032] The housing (11) of the device is constructed from durable materials that can withstand exposure to UVC radiation and various environmental conditions. The

housing includes a door mechanism (21) for easy access to internal components for maintenance and cleaning.

[0033] The UVC source (7) in the device is a high-efficiency lamp, tube or LED that emits UVC radiation within the germicidal range. It is selected based on wavelength, output power, and lifespan to ensure optimal performance for sterilization. The device's design positions the UVC source to maximize coverage of the target surface while minimizing the risk of UVC exposure to users.

[0034] Reflective surfaces (15) within the housing are made from materials that enhance the intensity and coverage of UVC emissions. These surfaces are strategically placed to direct UVC radiation toward the target area, ensuring thorough disinfection. The adjustable deflector (26) and reflective panel (15) on the door further enhance the device's effectiveness by allowing precise direction of UVC emissions.

[0035] The invention offers a comprehensive solution for surface sterilization using UVC emissions. Combining motion sensor (204), photovoltaic cells (202), rechargeable batteries (208), and adjustable deflectors (26), the device is effective, efficient, and versatile. Its design allows for use in a wide range of settings, from public spaces to private homes, providing a reliable means of maintaining clean and sterile environments.

[0036] The adjustable settings allow users to tailor the device's performance to their specific needs. These settings include options for adjusting the UVC cycle duration, cycle delay, and sensitivity. This flexibility ensures that the device can provide effective sterilization in different environments, from high-traffic areas to more controlled settings. The device's user interface (19) is designed to be intuitive and easy to navigate, enabling users to quickly and easily make adjustments as needed.

[0037] The invention also includes safety features to protect users from accidental exposure to UVC radiation. These features include a safety interlock system (211) that prevents the UVC source from being activated when the device is in motion or when motion is detected. Additionally, the device is equipped with reflective and deflector technologies to prevent accidental direct exposure of UV emissions. These safety features are essential for ensuring that the device can be used safely in a wide range of settings.

[0038] The materials used in the construction of the device are selected for their durability and resistance to UVC radiation. These materials ensure that the device can withstand prolonged exposure to UVC emissions without degrading or losing effectiveness. The housing (11) is designed to be easy to clean and maintain, with smooth surfaces and minimal crevices where dirt and contaminants can accumulate. This design helps to ensure that the device remains hygienic and effective over time.

[0039] The invention provides a comprehensive and versatile solution for surface sterilization, utilizing UVC emissions to disinfect surfaces thoroughly and efficiently. Its combination of motion sensor module (204), energy production module (202), rechargeable batteries (208), adjustable

deflectors (26), and safety features ensures that the device can operate effectively in a wide range of settings. The device's user-friendly design, ease of installing, and adjustable settings make it a practical and reliable tool for maintaining clean and sterile environments.

Detailed Description of the Preferred Embodiments.

[0040] The Sterilization Device comprises a housing (11) that contains the internal components of the device. The housing (11) is constructed from durable materials that can withstand exposure to UVC radiation and environmental conditions. It includes a door (21) that provides access to the internal components for maintenance and cleaning. The door (21) is equipped with a reflective layer that gives the ability to cast further the UVC emissions when the door is open.

[0041] The device includes a UVC source (7) that emits UVC radiation in the germicidal range. The UVC source (7) is mounted within the housing (11) and positioned to maximize coverage of the target surface. Reflective surfaces (15) within the housing (11) enhance the intensity and coverage of the UVC emissions, directing the UVC radiation toward the target area for thorough disinfection.

[0042] The Sterilization Device is equipped with motion sensors (204) that detect movement within a specified range. The motion sensors (204) are integrated into the housing (11) and are programmed to activate the UVC cycle when no motion is detected for a specified period of time. This ensures that the device only operates when it is safe to do so, minimizing the risk of exposure to UVC radiation.

[0043] The device includes photovoltaic cells (202) that convert light into electrical energy to power the device. The photovoltaic cells (202) are strategically placed on the device to maximize exposure to light, ensuring efficient energy collection. The device also includes rechargeable energy storage (208) that provide backup power, allowing the device to operate continuously even in low-light conditions or during power outages.

[0044] The device is equipped with an adjustable deflector (26) that allows the UVC emissions to be directed precisely where needed. The adjustable deflector (26) can be adjusted providing flexibility in various applications. The reflective panel (26) on the door (21) further enhances the device's effectiveness by increasing the surface area that can be sterilized.

[0045] The device includes an external power port (20) that allows the device to be connected to an external power source. This provides additional flexibility in high-traffic areas where the UVC sterilization device may be used more frequently. The external power port (20) is designed to be compatible with standard power sources, making it easy to integrate into existing infrastructure.

[0046] The device is designed to be easy to install and maintain. The housing (11) is constructed with smooth surfaces and minimal crevices to facilitate cleaning and prevent the accumulation of dirt and contaminants. The design also includes features that make it easy to access and maintain the internal components, ensuring that the device can continue to operate effectively over time.

[0047] The sterilization device provides a comprehensive solution for surface sterilization, utilizing UVC emissions to disinfect surfaces thoroughly and efficiently. The combination of motion sensor (204), photovoltaic cells (201), rechargeable batteries (208), adjustable deflectors (26), and safety features ensures that the device can operate effectively in a wide range of settings. The user-friendly design, portability, and adjustable settings make the device a practical and reliable tool for maintaining clean and sterile environments.

[0048] Brief Description of the Drawings:

Figure 1 shows a top view and a front view off the Sanitation Device.

Figure 2 Shows the top and front view of the Sanitation Device with different lengths.

Figure 3 shows two side views.

Figure 4 shows the side views with the door open and cover off.

Figure 5 Shows 4 separate figures of slices of the unit from a side perspective.

Figure 6 shows interior views of door with deflector open and closed.

Figure 7 Shows the hardware that are attached too the interior of the door.

Fgure 8 shows various angles of Door construction and parts locations.

Figure 9 Shows front elevation of PLU1.0 and the Door.

Figure 10 shows the back panel and the mounting plate.

Figure 11 shows the front part of the invention, with removed doors and casing.

Figure 12 shows the backplate and mounting plate.

Figure 13 Block Diagram of modules and description of operational flow.

[0049] Description of Preferred Embodiments:

1. Printed Circuit Board
2. Motion Sensor
3. Electronic Chamber
4. Photocells
5. Transparent Window Insert
6. Guide Pin
7. UV Emitting Part
8. Open/Close Arm
9. Turn-wheel
10. Batteries
11. Outer Casing
12. Interior Visor
13. Photocell Beds
14. Fastener Location
15. Reflective Layer
16. Window Cutout
17. Substrate

18. Pin Channel

19. On/Off/Override Switch

20. External Power Port

21. Door

22. UV Chamber

23. Backplate

24. Side Visor

25. 90 Degree Lip Area

26. Door Deflector

1. Deflector Hinge

28. Male Door Hinge

29. Deflector Pin

30. Beveled Edge

31. Rolled Area

32. Hand Shaped End

33. Mounting Assembly

34. Metal Cylinder

35. Mounting Plate

36. Notch

37. Male Door Hinge

Modules:

201. Battery Charger Controller Module

202. Energy Production Module

203. External Power Module

204. Motion Sensor Module

205. Circuit Switching Module

206. Sanitation Timer Module

207. UV Load Module

208. Energy Storage Module

Best Mode for Carrying out the Invention:

[0050] In order to better understand the subject matter that is disclosed herein and to show examples of how it may be carried out in practice, embodiments will now be described, by way of non-limiting examples only, with reference to the accompanying drawings, in which:

[0051] The Sanitation Device is a UVC emitting unit designed for sanitation of walls, counter-tops, push-plates on doors, elevator panels or anywhere contact is made and bacteria or virus can be spread by human contact. It is a simple and smart design with ease of use and reliability kept in mind while constructed. The PLU1.0 is photovoltaic powered and has its own power storage cells located inside. It has an adjustable safety timing delay that begins the disinfection cycle after motion has ceased and there are no people or animals within a specified amount of distance from the device. The distance can be adjusted.

[0052] Figure Fig 1A and IB depict the exterior dimensions of the Sanitation Device

[0053] Fig 1A shows the top elevation and shows part [5] transparent window insert, which can be made of glass or plastic or a similar transparent material. This is used to easily pass light to the photovoltaic cells directly behind the [5] transparent window insert which is fitted flush with the [11] Outer casing by means of the window cutout 16, which is comprised of the missing section(s) of the casing and is where the window inserts and photocells are situated behind, which can be made of numerous types of materials, this figure shows how the outer parts are composed and the device’s parts are situated .

[0054] Figure IB shows the front elevation and includes part [5] Transparent Window Insert, and indicates the motion sensor [2] and how it is situated in the Sterilization Device. The [19] user interface switch, which has a fixed on and off position and a override switch. Touching all these parts is the [11] housing which is flat and smooth and has no features for items or clothing to be snagged by or caught in and a low profile to avoid contact with people and objects in motion.

[0055] Figure A2 and 2B are front and top views of a compact version of the device and shows part [19] user interface, and part [2] Motion Sensor. Although a dome is depicted in the illustration to set perspective of the drawings, the [2] Motion Sensors actual construction may include a flat Motion Sensor or recessed or square motion sensor. The dome is used for ease of understanding of drawings in setting direction and perspective of devices position and view.

[0056] Figure 2A shows a proportional top elevation leaving room for the [5] transparent window insert(s) which are in front of the photovoltaic cells that are shown in later figures and which absorb the light and heat the transparent inserts [5] allow to pass.

[0057] Figure 2B shows again the front and top views as well as the approximate locations of [5] transparent window insert(s). This is a longer unit in dimensions with more photovoltaic cells located on the front and top of the units surface just behind the [5] transparent inserts. This figure notes basic exterior features including the [11] Outer Casing, and the [5] Transparent Window Insert. The [5] Transparent Window Insert is sized to fit the [16] window cutouts in the [11] Outer casing and is secured in place with fasteners, hardware plate or adhesive materials or a combination of materials from behind the [11] housing.

[0058] Figure 2C Shows the PLU1.0 with a greater length than previous figures 2A and 2B. It shows the [5] Transparent window insert. Also can be seen is the advantage to the longer dimensions and how the photovoltaic cells and transparent window inserts do not need to appear on the top or sides of the unit and the unit can have less depth due to the amount of surface area the

photocells can use to harvest energy from light utilizing only the front surface area which reduces the depth needed for energy production devices and keeps the units canter-lever from its attached surface to a minimum.

[0059] In figure 3A we see a side view of the Sanitation Device. Here parts [5] Transparent Window Insert with the [4] Photovoltaic cells underneath, The [20] External power port is shown and its approximate arrangement in the device. Even

though the photocells create ample energy for light to medium use this option is available for recharging power banks that have been completely depleted or for a fast charge, it is also a very useful element for heavy traffic areas where the load is in constant use. The [19] On/Off/Override interface is located non limiting on the side of the machine but can be located alternately, the user interface and the external power input are depicted in oval or circular shape even though they can be of a variety of shapes and connection types and may be combined. This figure also shows the [21] Door of the device which opens and closes to cast and direct UVC rays further.

[0060] Figure 3B shows the alternate side which is mostly identical to previous figure 3A except for the absence of the On/Off/Override inteface and the external Power Input.

[0061] Figure 4 shows various side views of the Sanitation Device with [21] Door in full open position at approximately ninety degrees, and the outer casing off, exposing the Substrate [17] and the photocells [4] are seen exposed.

[0062] Figure 4A Depicts a side view of the invention and shows the simple open close hardware system for the [21] door. The Open/Close Arm [8], can stop at any point from zero degrees to approximately ninety degrees. The locations of hardware are also identified here. The figure shows the [21] Door fully extended to its 90 (ninety) degree open position as opposed to its 0 (zero) degree vertical position also referred to as “at rest” which was shown in the previous figures. The Door [21] has a [36] notch, where the [8] Open/Close Arm attaches, and keeps the [8] Open/Close Arm flush with the interior plane of the [21] Door, the notch is positioned on the side and interior of the device and this part of the door, where the notch [36] exists the corner is removed and replaced with the hand shaped area[32] of the arm [8] so the doors surface and the open close hardware are flush and true and are the fasteners used through out construction of the device. The [9] turn-gear is shown here, and is used too manually open and close the [21] Door, by use of the [8] Open/Close Arm,

which is kept aligned by means of the [6] guide pin, which is stationary and secured to the main part of the device. The [9] turn-gear is mounted to the [17] substrate on the legs of the device and also are the Guide Pins [6]. The [8] Open/Close Arms are mounted to the door of the device at the [36] notch. Part number [6] Guide Pin is used to stabilize and guide the [8] Open/Close Arm by way of a [18] pin channel cut in part No.8 Open/Close Arm , the pin channel [18] is integrated into the open/close arm [8] and is smooth and both edges run parallel in the middle of the curved arm [8] to make available a smooth function of the door operation system the. The [35] mounting plate is where the unit attaches to the wall or other flat surface. The [23] backplate is secured to the rear of the invention and helps secure it to the mounting by offering circular passages for fasteners to pass which originate in the front of the invention and terminate in the mounting plate[35]. The recessed groove helps connect the [17] substrate to the [11] outer housing and is used as a linear hitch for mounting and securing the [11] housing which is cut at an angle to permit UV emissions to escape out the bottom sides of the machine to broaden the target surface area.

[0063] Figure 4B shows the alternate side of the unit with outer casing otherwise known as the housing [11] off and the open/close arm [8] hardware locations shown through the transparent substrate[17]. The [4] Photovoltaic cell is also shown as well as possible locations of [19] On/Off /Override and the [20] External Power Input (port). As is logical when a unit has photocells [4] on the door and the angle of the door changes so too will the energy absorption angle of the Photocell. When the [21] Door is in its 0 degree or at rest position the part [4] Photocells will also be in vertical position(0 degrees) also referred too as at rest. To open and close the Arms [8], simply turn part [9] turn-gear which makes contact with the toothed edge [41] of the open/close/arm [8]. The way the opening and closing hardware is configured, pushing [9] turn-gear from the bottom side towards the back of the machine opens the door, and by pulling the [9] turn-gear on the bottom side towards the front of the machine closes the door. The figure also points to the motion sensor [2], and the pin channel

[0064] Figure 5A, 5B, 5C, 5D, depicts slices of Sanitation Device from a side viewing position.

[0065] Figure 5A Shows the side view of the Sanitation Device. The location of parts and the exemplaiy design of the interior structure of the [22] UVC chamber and the [3] electronics chamber which may vary slightly from the figures. The [17] substrate is the main part of the device and connects and touches most parts and all modules of the device. The substrate [17] can be made of any material suited for mounting devices substrate. Non-limiting examples would be plastics, metals or woods. The [2] Motion Sensor may be domed, flat, recessed or any other usual shape, although depicted as a dome for ease of translating drawings. The Photovoltaic cells are located in the [13] Photocell beds which are located and incorporated into the substrate [17] and are where the photocell(s) are secured into place by adhesive or hardware or a combination of materials. The [13] Photocell beds are sized to fit the Photovoltaic cells, and have channels and holes on the surface of them which are used as basic electrical conduit to accommodate passage of wiring or other technology to and from the electronics chamber [3]. The [13] Photocell Beds are a part of the [17] substrate and are frames for the photocells too rest in. The [10] Power Storage is located in the upper section of the Sanitation Device just below the roof of the [17] substrate and behind the top row of [4] Photovoltaic cells on the roof of the unit and behind the front row of [4] Photovoltaic cells located on the front of the unit. The [15] Reflective layer can be made of various materials. A mirror reflective finish is suited best, however other reflective grades can be used depending on UVC refraction, diffusional and reflective properties desired. Planes and grades of the [15] Reflective Layer may vary with each UVC emitter placement. Ridges, bends, folds and other manipulation of the [15] reflective layer can be adjusted with variables including size, shape, type of shape, area of coverage desired, amount of light, reflective patterns, and other factors calculated by the UVC emitting part(s) locations and UVC casting specifications desired. The [12] Interior visor is a deflector and a reflector it blocks direct UVC rays from exiting the machine without being reflected before departure. The reversed side of part of [12] Internal Visor is also reflective and projects the UVC load outwards and away from the device. The internal visor [12] is attached by use of fasteners or adhesives. The [7] UVC emitting part is attached by means of clips, screws, adhesives, socket, cradle fixed LED tape or similar embodiment.

[0066] Figure 5B Shows a drawing exactly as 5A except for a change in the UVC emitting part. For this figure the UV-C emitting part are ultraviolet LED’s. The LED(s) are mounted in a cradle or in a strip and are situated inside the machine so the direct contact radiation UVC field does not extended past the horizon line of the device. At no point will a UVC be situated at a point where the horizon

line is visible from the Point Of View of the UVC source element [7]. The [12] interior visor will be sized and fitted to the unit by use of adhesives or fasteners or the like so no horizon line is visible from the point of view of the UV-C emitting part(s) and to insist that no UVC radiation escape the device without prior reflection. The doors reflective layer is seen angled here again as in other figures, this feature is used to better place the UVC load onto the surface the invention is mounted to and creates the downward diagonal cross slope of UVC emissions for better coverage of surfaces below the the unit.

[0067] Figure 5C Shows a side view slice of the device, with part [1] Printed Circuit Board(s) situated in the [3] Electronic chamber. It also shows the [204] Motion Sensor Module. As you can see by the side view, the Sanitation Device has the embodiments which prevent direct UVC radiation from escaping the Device without prior reflection off at least one surface [12] interior visor. In this figure the UVC emitter is situated where its direct waves are blocked by the [12] interior visor which stops UVC from escaping strait down through the open bottom. But instead redirects it to the ceiling of the [22] UVC chamber which is covered with the [15] reflective layer and redirects the UVC where it either reflects off the [15] reflective layer surface or departs the device and heads for the sanitation target area outside of the device.

[0068] Figure 5D Shows the other side of the unit and points out [22] motion sensor controls which are preset by the user and affect the time duration prior to Sterilization cycle beginning and the sensitivity of the device for distance adjustment by turning the two thermistors or rheostats that regulate these settings, the device can have the controls located in an easily accessible area but are shown in position inside the electronics chamber.

[0069] Figure 6 shows the interior of the [21] Door.

[0070] Figure 6A Shows the [21] Door interior view which is covered by a [15] reflective Layer over the entire interior surface of the door less the peripheral area where the outer housing [11] wraps around and is fit tight to the doors substrate. The [28] Door Hinge is an integrated section of the door and is the same depth as the door with all parts assembled. The top of the [28] hinge area has a double bevel edge [30] so the door is available to swing open without interference from the main body of the Sanitation Device. The [24] Door Side Visor is shown from an angle where its 90 degree bent [25] lip is shown with fastener locations [14] depicted as small circles running vertically along the visor lip [25] this is where the [24] side visor attaches to [21] Door. Adhesives may be used or a combination of fasteners and adhesive can be used as well as solder or clips to make the attachment. The drawing also shows boundaries of the housing [11] which runs around the peripheral of the interior of the door and terminates at the reflective layer [15] and the side visor [24] on the sides and at the deflectors hings [27] on the bottom side of the door as shown in this figure as the 4 rectangular shaped which comprise the outer perimeter of the interior of the door less the protruding female door hinge areas [28] which occupy the perimeter of the top comers of the door and is where the door is attached to th substrate of the device. There is also a [26] Door Deflector which is attached to the [21] Door by means of the [27] Deflector Hinge. Part No. [26] door deflector is at rest in vertical position and swings 180* degrees back to vertical but in an extended position, to deflect and reflect the UVC load. The [26] Door Deflector can be reflective in nature or offer various

reflective grades for casting and deflecting the UVC load. The deflector hinge [27], is a rolled part of the [26] door deflector and a rolled part of the [15] reflective layer. Both parts [26] door deflector

and [15] reflective layer are a thin sheet metal and each has its one end rolled alternately. When the two rolled parts are conjoined their rolled areas create the [27] deflector hinge by passing the hinge pin through the cylindrical hollow shape that is made and in doing so interlock with each other. The [34] deflector pin is then bent in opposite directions at both far ends outside of the [27] deflector hinge too secure it and the [27] deflector hinge in place.

{0071] Figure 6B is the same as 6A except the [26] door deflector is shown in its 180 degree position and is fully open. In both figures [24] side visor is shown as a thin strip from this angle and the 90 degree lip [25] is also shown with multiple locations of [14] fastener locations. The figure shows where the {8] open/close arm attaches to the [36] notch in the door. The housing[ll] is shown around the edge of the door and is wrapped tightly and terminates at the [15] reflective layer.

[0072] Figure7 depicts the Open/Close hardware and the door side visor.

[0073] Figure 7A 7B and 7C shows various angles of the [8] Open/close arm which is attached to the notches of the interior of the [21]door by use of the hand shaped area [32]. Figure 7A is the [8] Open/Close Arm with one edge being a toothed rail [41] which fits the gears on the turn-wheel which is attached to the substrate or casing. In figure 7B the side of the the [8] open/close arm is depicted in this section with the [32] hand shaped area, this is the end that fits into the [36] notch on the interior of the door, the [32] hand shaped area is attached into the [36] notch with fasteners at the [14] fastener locations, Figure 7(b) Shows the [14] fastener locations in an alternate view which is the end of the [8] Open/Close Arm. Figure 7(c) is an alternate angle of the [8] open/close arm and shows the [32]hand shaped area more clearly. The “L” section of this area grips the side and the interior of the door in the [36]notch and stabilizes the [8]open/close arm. Figure 7B shows the opposite end of [8] open/close

arm as well and the slight protrusion named the L protrusion [42] which is the termination point for the doors movement. When the L protrusion reaches the [9] turnwheel it is unable too pass and this becomes the maximum extension of the [8] open/close arm and is also the maximum extension possible for the [21] door and all elements comprising it. The end with the “L” protrusion [42] is not attached to anything but hangs freely in the [22] UVC chamber. Along the curved [8] open/close arm is a [18] pin channel cut through and which travels lengthwise along its curvature, it is here in this [18] pin channel that the [6] guide pin in located. The [6] guide pin is attached to the [21] main body or the [11] outer casing, either is suitable for the task of keeping the [8] open/close arm aligned. Figure 7(e) shows The [6] guide pin, this piece in itself is a strait short piece of metal which has a head on one end that keeps the [8] open/close arm from becoming dislodged while it keeps it aligned and aids in keeping the door functioning correctly as the [8] open/close arm slides to and fro during [21] door operation. Figure 7D Shows the side view of the Door Side Visor [24] and shows the lip which is a bend or fold in the side visor and creates the [25] lip area that is bent at a 90 degree angle to form a flat area that mounts to the interior side of part No. 21 Door. The lip [25] has a notched section matching the [21] doors notched section to allow the [8] open/close arm to attach properly to the [21] door without interference. Figure 7(g) Is an alternate view of part No.24 Door Side Visor and shows area [25] lip as a thin sliver from the orthographic perspective of the drawing. Figure 7(h) shows yet another angle of [24] door side visor and shows more clearly the [36] notch and the [14] fastener locations for attachment to the [21] door.

[0074] Figure 8 shows various side profiles of the [21] Door with door hardware attached.

[0075] Figure 8A and 8B shows the alternate side profiles of the [21] door. They depicts part [26] Door Deflector in full open and full close positions which is a variation of approximately 180 degrees. It also shows [27] Door Deflector Hinge

which consists of [27] deflector hinge being a 2 part system of rolled ends of the [15] reflective Layer. The second part of part number [27] Door Deflector Hinge is the rolled part of [26] Door Deflector with a third component added which is a long pin, [34]deflector pin. When the deflectors bent hinge area and the reflective layer's [15] bent area are aligned a pin is inserted between them and bent at both ends in opposite directions which is used too secure [34]deflector pin and keep it from dislodgement.

[0076] Figure 8C and 8D are each a profile of the opposite ends of the [21] door. In these figures it shows hows the [24] door side visor is situated and connected too the [21] door.

[0077] Figure 8E and 8F Show alternate side views of the [21] Door with the [24] Door Side Visor attached as well as the [8] Open/Close Arm. The [9] Turn Gear and [6] Guide Pin are mounted to the substrate [17] of the sanitation device. The [8] Open/Close Arm is attached to the [21] Door. The [8] open/close arm interacts with the [9] turn-wheel and the [6] guide pin however both parts [9] turn-wheel and part [6] guide pin are attached to the [17] substrate of the invention.

[0078] Figure 9 shows the [15] reflective layer and the [26] Door deflector by themselves. As you can see they both have [31] rolled area at their end portions where they meet and interlock with the aid of the [29] deflector pin. Figure 9A shows the [26] door deflector and shows the [31] rolled area which align with the rolled part in figure 9D which shows the adjacent rolled parts attached to the [15] reflective layer. Figures 9B is the side profile of the [26] door deflector and shows it in various states of use. 9C shows the [15] Reflective layer in an upright position. Figures 9C is the side profile of the [15] reflective layer which is permanently attached to the interior of the door and which is immovable. Figure 9D is a front view of the [15] reflective layer and shows its [31] rolled area which fits snugly between the rolled area of the [26] deflector. After which the Deflector hinge pin [34] depicted in figure 9E is inserted longways through all of the open hollow channels created in the center of the [31] rolled areas of both the [26] deflector and [15] the reflective layer. After the two parts are connected with the deflector hinge pin [34] the pin is bent in opposite directions at 90 degree angles on both ends so it is fixed place and does not become dislodged as depicted in 9E.

[0079] Figure 10 shows the front of the unit and the exterior of the door.

[0080] Figure 10A Shows again the front of the unit and the locations of [11] housing, [21] door, [2] motion sensor, [19] On/Off/Override switch and [28] hinge area which is an integrated part of the [21] door.

[0081] FigurelOB Shows exterior view of the [21] Door, part [28] Door Hinges, the [5] transparent window inserts and the outer housing [11].

[0082] Figure 11 Shows the front of the Sanitation Device with the Door removed and the [11] outer housing removed, it shows locations for door hinges and the hardware parts used as [39] Male Door Hinges.

[0083] Figure 11A Shows the front view of the device and points to the substrate [17], the Electronics Chamber [3], the motion sensor and motion sensor module are removed. The figure also shows instructions on how the door is assembled by way of the [39] hinges and shows approximate location of part number [39] Male Door Hinges. Wheen assembling the invention the [39] male

hinges are inserted into the cylindrical hollow chamber that is integrated into the [21] door, and noted as [28] female door hinge(s) which is an integrated area of the [21] door. After the [39] male hinge is inserted into the hollow cylindrical chamber of the [28] female door hinge, the [39] male hinges caan be fastened to the [17] substrate by use of the [14] fastener locations, after which the [11] housing can be attached over the [17] substrate and in doing so cover completely the [38] male door hinge.

[0084] Figure 11B shows two top views and two side views of part number [39] Door Hinges and points to the [14] fastener locations.

[0085] Figure 11C depicts the door and calls out parts [28] Female Door Hinge which is an integrated area of the Door. It also calls out the [5] Transparent Window Insert and[ll] Outer Casing. The [11] casing for the door is minimal and only covers the outside borders of the interior and exterior of the invention due to the [5] transparent window inserts on the outside and the reflective material covering the interior of the door. The door [21] is attached to the hinges [38], the hinges [38] are attached to the substrate [17], and the casing [11] covers the [38]male hinges.

[0086] Figure 12 depicts the mounting assembly for attaching to surfaces and the backplate [23] which covers the rear of the invention.

[0087] Figure 12A depicts the rear cover of the Sanitation Device named the [23] backplate. The [14] fastener locations are where the backplate[23] attaches to the device. The [23] Backplate can be made of various materials suited for the application of covering the [3] electronics chamber of the device. The [33] Mounting Assembly is where the fasteners that protrude through the device from the front of the invention and attach to the [35]mounting plate. The assembly can also include [37] metal cylinders that are hollow in the center and which the fasteners pass through and are used as jackets for strength and to prevent the fasteners from damaging the Sanitation Device.

[0088] Figure 12B shows the [35] mounting plate and how it aligns with the [33] mounting assembly location. The figure also shows [14] fastener locations for attachment to a wall or other surface and their locations.

[0089] Figure 13 Block Diagram of Modules

[0090] Module [208] Power Storage Module. Module [204] is the Motion Sensor Module which detects motion and has adjustable distance and time adjustments to delay the activation of the sanitation cycle. Module [205] Circuit Switching Module, resets and triggers the Sanitizing Timer Module [206]. Module [206] Sanitation Cycle Timing Module, regulates the time duration for the sanitizing cycle. Module [207] UVC Load Module, is where UVC radiation emits from and includes circuit components for regulation of the UVC emitting elements. The Batteiy Charger Controller Module [201], houses the batteiy charge controls and incorporates an External Power Input Module [203] along with the Power Generation Module [202].

[0091] Its a very simple process and invention. When the [204] motion sensor module detects motion, It sends a signal to the [205] switching module which inverts the signal. When the signal from the Motion sensor module [204] ends the switching module then sends a signail to the Timer Module [206], the timer is restored to its active cycle and the timer countdown begins as the timer outputs a high signal it powers the UVC emitters by way of the power regulation circuitry parts which are included in the UVC Load Module[207]. If new motion is detected before the sanitation cycle is finished the [204] motion sensor module sends out a high signal to the switching module

[205] and again the timer deactivates the UVC load module until the cessation of motion ceases and the signal from the [204] motion sensor module goes low which deactivates the circuit switching module [205] and the timer begins again, ad infinitum.

Industrial Applicability

[0092] The sterilization device described in this application has significant industrial applicability across various sectors. Its design and functionality make it suitable for use in industries where hygiene and sterilization are paramount. Below are examples of its applicability in different industrial settings:

1. Healthcare Facilities: The sterilization device can be used in hospitals, clinics, and dental offices to disinfect surfaces and equipment. Its ability to emit UVC radiation ensures the elimination of harmful microorganisms such as bacteria, viruses, and fungi, thereby reducing the risk of healthcare-associated infections.

2. Food and Beverage Industry: In food processing plants and commercial kitchens, the sterilization device can be employed to maintain hygiene standards by disinfecting surfaces and equipment. The use of UVC radiation helps in preventing contamination and prolonging the shelf life of food products by reducing microbial load.

3. Pharmaceutical Manufacturing: The device can be utilized in pharmaceutical production facilities to sterilize equipment and work surfaces, ensuring that products are manufactured in a contamination-free environment. This is crucial for maintaining the purity and efficacy of pharmaceutical products.

4. Public Transportation: Public transportation systems, such as buses, trains, and airplanes, can use the sterilization device to disinfect seats, handrails, and other high-touch surfaces. This helps in reducing the spread of infectious diseases among passengers.

5. Hospitality Industry: Hotels, restaurants, and other hospitality businesses can employ the sterilization device to maintain cleanliness and ensure the safety of their guests. It can be used to disinfect guest rooms, dining areas, and kitchen surfaces.

6. Educational Institutions: Schools and universities can use the device to sanitize classrooms, laboratories, and common areas. This helps in creating a safer environment for students and staff by minimizing the risk of infection.

7. Office Spaces: In corporate offices, the sterilization device can be used to disinfect workstations, meeting rooms, and common areas. This is particularly important in reducing the transmission of infectious diseases in workplaces, ensuring a healthier environment for employees.

8. Laboratories: Research and diagnostic laboratories can utilize the device to maintain a sterile environment, which is essential for accurate testing and experiments. The UVC sterilization device can be used to disinfect work surfaces, instruments, and equipment.

9. Fitness Centers: Gyms and fitness centers can employ the device to disinfect equipment, locker rooms, and exercise areas. This helps in maintaining a hygienic environment for users, reducing the risk of infections.

10. Public Restrooms: The sterilization device can be installed in public restrooms to disinfect surfaces such as toilet seats, handles, and sinks. This ensures a higher level of cleanliness and reduces the spread of germs in these high-traffic areas.